Period prior to interference of morning glory in sugarcane

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Abstract
Sugarcane had great change in its production environment with the adoption of mechanized harvesting, highlighting the increasing importance of morning glory, for which there is no information about its interference in sugarcane cycle. The aim of this study was to determine the period prior to interference (PPI) of a weed community with predominance of Ipomoea hederifolia on sugarcane ‘SP81-3250’ in sugarcane plant cycle and its effect on technological parameters. Treatments consisted of increasing coexistence periods at the early of the cycle: 0, 0-15, 0-30, 0-45, 0-60, 0-75, 0-90, 0-120, 0-150, 0-180, 0-210, 0-270, 0-330 days after emergency. A randomized block design with four replications was used. Phytosociological analysis of weed community was performed, which confirmed morning glory dominance in the community and PPI obtained was 76 days after emergency, with a level of 5% of acceptable loss. The yield loss of industrialized stems due to morning glory interference was 17.5%. There was no change of sugarcane technological parameters.

Additional keywords: competition; Ipomoea hederifolia; periods of interference; Saccharum spp.

Introduction
The culture of sugarcane had significant change in past years. The burning of sugarcane plantations, ordinary activity in the past, has been losing importance, due to society pressures and legal requirements, which lead to the prohibition of sugarcane plantation burning, as in the state of São Paulo, that follows scheme of progressive legal restrictions - 20% by 2010; 30% by 2012; 50% by 2014; 80% by 2018; and 100% by 2020 (Monquero et al., 2011).

Mechanized harvesting without prior burning greatly changed sugarcane management. One of the main changes occurred in the management of weeds (Ferreira et al., 2010; Azania et al., 2011). The permanence of a dense straw on soil significantly changed the composition of sugarcane weed community (Azania et al., 2008, 2009, 2011). The straw layer kept in this system acts as a physical barrier for seeding emergence and for positioning of pre-emergent herbicides, changing water balance, temperature range of soil surface, quantity and quality of light (Ferreira et al., 2010; Velini & Negrisoli, 2000).

Some studies have shown that morning glory species, before with little expression, are among the main ones on environment provided for mechanized harvesting (Monquero et al., 2011; Ferreira et al., 2010; Kuva et al., 2007). The growing importance of Ipomoea plants in sugarcane fields increases the need for information on the biology of these plants in ratoon sugarcane cycle, given the enrichment of the seed bank with species of this genus. However, there is still no information on the possible interference that morning glory can cause on sugarcane productivity in...
sugarcane plant cycle.

Pitelli & Durigan (1984) define the period prior to interference (PPI) as the period where culture can coexist with weed community without economic damage. PPI begins with the emergence of culture and ends with the early of interference, thus it is necessary to determine a percentage of acceptable loss to establish it, usually equal to or below control cost. Silva et al. (2009) determined PPI of a weed community with predominance of *I. hederifolia* on cane ratoon (fifth cut) cultivar RB85-5536 considering 5% of loss in productivity. The reduction of sugarcane steam productivity was 46% and PPI was 33 days after sprouting of sugarcane.

Given the reported, it is proposed the hypothesis that period prior to interference of *I. hederifolia* on sugarcane is different from sugarcane ratoon determined by Silva et al. (2009). Thus, the aim of this study was to determine PPI of a weed community with predominance of *I. hederifolia* on sugarcane 'SP81-3250' in sugarcane plant cycle and the effects of interference in productivity and technological parameters of culture.

**Material and methods**

The experiment was conducted from January 2012 to April 2013, in the municipality of Santa Juliana - MG (19º 18’32” South latitude and 47º31´27” West latitude, altitude of 1000 m), in commercial production area. Preceding sugarcane planting, sorghum sowing was carried out. At desiccation (12/05/2011) sorghum plants about 20 cm predominated. It was used isopropylamid glyphosate-salt at 648 g L⁻¹ (480 g e.a. L⁻¹) and trifluralin 600 g L⁻¹.

Sixteen days after desiccation harrowing for incorporation of dry residue was performed. After thirty days sugarcane planting was performed (5 and 01/06/2012), period of "planting of year-and-half," the semi-mechanized system ("hybrid" mode). The area was furrowed (spacing of 1.5 meters between rows, 30cm depth) and mechanically fertilized (13-20-25 fertilizer at the rate of 0.5 t ha⁻¹) using a fertilizer furrow openers. The cultivar used was SP81-3250.

The treatments consisted of increasing periods of sugarcane coexistence with a weed community with predominance of morning glory: 0, 0-15, 0-30, 0-45, 0-50, 0-60, 0-75, 0-90, 0-120, 0-150, 0-180, 0-210, 0-270, 0-330 days after emergence (DAE). Emergence of sugarcane first plants was considered as the early of the coexistence (01/23/2012).

The experimental design was a randomized block with treatments in four replications. Plots were composed of five sugarcane rows with ten meters length. Borders of plots were considered one meter at each end and two sugarcane rows, totaling 36 m² of useful area.

In order to keep the area free of other weeds selective weeding were performed (manual weed control that were not *I. hederifolia*). In addition, all necessary measures to maintain the good health culture were also taken.

After the end of coexistence period regarding each treatment, a randomized sample of weeds was carried out by collecting four samples per plot using drained square of 0.25 m². The plants contained within square were collected, identified, quantified and dried at 70°C to determine its dry mass (g m⁻²). These samples of weeds generated data to calculate the importance value index - IVI (Müller-Dombois & Ellenberg, 1974).

The harvest of sugarcane was manually performed without prior burning at 15 months after planting. The steams of useful area were cut and packed into a single lot per plot. Thereupon, it was heightened using loader equipped with load cell. The mass data per plot were the basis for production calculation per unit area (t ha⁻¹).

To determine PPI (period prior to interference) productivity data from sugarcane was used. These data were submitted to regression analysis by sigmoidal model of Boltzmann, adapted by Kuva et al. (2000). For this determination, it was considered the value of 5% as acceptable loss in productivity.

**Results and discussions**

There was increased density of morning glory plants at 270 days after emergence (DAE) due to a new flow of seedlings (Figure 1). On this occasion, in October 2012, the seeds of *I. hederifolia* produced by the first generation germinated and emerged, but in low density. The emergence of morning glory in October was directly related to the occurrence of new rains (approximately 80mm) after the dry season from June to September, emerging in high density. Therefore, it can be said that there were two weed cycles in a single crop cycle.

Other species besides morning glory were present during trial period. However, the dry mass of these other species was always low (Table 1), indicating that they were newly emerged and their importance concerning community was small or even negligible, as can be seen by analyzing importance value index (IVI), which considers the participation of each species in community according to the frequency of occurrence, its density and its mass accumulation (Müller-Dombois & Ellenberg, 1974).
The morning glory was the species with the highest dry mass accumulation in all evaluations, except for 15 DAE. On the other hand, crabgrass (*Digitaria nuda* Schum), which at 15 DAE was the species with the highest dry mass percentage of the community, from 30 DAE showed pronounced decrease, and after 150 DAE, its participation in dry mass of community was practically null. Another species that initially stood out was *southern sandbur* (*Cenchrus echinatus* L.). On second position at the first assessment (15 DAE), it has become almost 0% after 45 DAE. A similar fact occurred to tropic ageratum (*Ageratum conyzoides* L.), which started on third in the participation in community dry mass at 15 DAE and reached approximately 0% at 45 DAE.

Silva et al. (2009) found the maximum dry mass increment (DM) of morning glory (*I. hederifolia*) in the interval from 75 to 125 days after sprouting of sugarcane (DAS), when it reached about 450 g MS m\(^{-2}\). In the period between 0 and 50 DAS, the dry mass accumulated by this species was 0-1.70 g m\(^{-2}\). After 150 DAE, the participation of morning glory in dry mass of community was practically null.

The *southern sandbur* (DAS) showed the highest dry mass increment (DM) (163.60 g m\(^{-2}\)) at 45 DAE, and after that, it showed a pronounced decrease until 150 DAE, when its participation in dry mass of community was practically null.

<table>
<thead>
<tr>
<th>DAE</th>
<th>Tropic ageratum</th>
<th>Morning glory</th>
<th>Southern sandbur</th>
<th>Crabgrass</th>
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<td></td>
<td>Average</td>
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<td>84.50%</td>
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DAE = days after emergency; *M*<sub>i</sub> = Species mass; *M* = Total mass
mass accumulation was small, not exceeding 10 g MS m\(^{-2}\), following the mass accumulation of weed community, similar behavior to that observed in this study. In an essay in the greenhouse, *I. hederifolia* reached its maximum development at 140 DAE (Guzzo et al., 2010). After this period, plants lost weight, possibly due to senescence. The dry mass accumulation of morning-glory plants has reached its maximum value at 180 AED, when there was also the early of seed production.

Importance value index (IVI) adds relative density (RD), relative frequency (RF) and relative density (RD) data (Braun-Blanquet, 1979), as already mentioned. Morning glory showed the greatest value of IVI (Figure 2), confirming that weed community presented predominance of this species during the trial period. In a survey conducted in 70 plants, Ferreira et al. (2011) found that *I. hederifolia*, according to IVI was the third species in importance.

The productivity regression analysis due to coexistence periods with weed community provided a period prior to interference (PPI) of 76 days after emergence (DAE) (Figure 3), i.e. in a year-and-half planting of cultivar SP81-3250, *I. hederifolia* caused productivity loss from 76 DAE of sugarcane, considering 5% as productivity acceptable loss. Silva et al.(2009), also working with *I. hederifolia* obtained for cane ratoon, a PPI of 33 DAE in cane ratoon.

In sugarcane plant, chemical control can be done using two herbicide applications. The first application is usually performed just after planting, while the second application is performed prior to the closing of sugarcane, after the leveling operation field, named “hilling-up” (when performed). Sugarcane planted in the Southeast in January rapidly develops due to the high temperature and water presence. The second herbicide is between 60 and 90 days after planting.

When it is stated that PPI for morning-glory under trial conditions was 76 DAE of sugarcane, it can carry out one application of post-emergence herbicides in this period when there is a predominance of *I. hederifolia* in weed community. However, Tironi et al. (2012) found reduced productivity (TCH - tons of sugarcane per hectare) when herbicides were applied at post-emergence of sugarcane (three to four fully expanded leaves). Thus, it is recommended the morning glory control at the first application, even PPI more than 70 DAE.

The steam yield loss was 17.5\%, lower than the 46\% obtained by Silva et al.(2009), which can be attributed to differences on cultivation, production environment and management system (sugarcane plant x ratoon cane). Azania et al. (2009) observed that plants of the genus *Ipomoea, Merremia* and *Euphorbia* can provide up to 24\% of loss in sugar cane productivity.

![Figure 2](image-url) - Importance value index (IVI) of each species of sugarcane weed community ‘SP81-3250’.

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Figure 3 - Period Prior to Interference (PPI) determination of a weed community with predominance of Ipomoea hederifolia on productivity of sugarcane 'SP81-3250'.

According Guzzo et al. (2010), plants of I. hederifolia present its higher extraction of macronutrients at 63 DAE, period next to PPI occurrence obtained in this study (76 DAE). Pitelli (1987) classifies as "direct interference" the competition for nutrients and states that this is one of the most important forms of interference between weed and crops.

There was no effect of coexistence periods on the qualitative characteristics of harvested sugarcane, whose average values were: 82.66% of purity, 10.64% of fiber, 10.19% of Pol and 104.57 kg t⁻¹ of ATR (Total Recoverable Sugar), these last two parameters indicate quantity of stored sugar. These results can be attributed to harvest period and water regime, which favored the maintenance of ATR values. The sugarcane received a strong incentive to continue to vegetate in the last months pre-harvest due to accumulated rainfall (about 300 mm). According to Casagrande (1991), when there is a prevalence of vegetation, over the maturation process, the accumulated sugar is rapidly hydrolyzed and sucrose is used in the growth mechanism.

Conclusions

In a weed community with predominance of morning glory (Ipomoea hederifolia), the obtained PPI considering maximum loss in productivity of 5% was 76 DAE of sugarcane ‘SP81-3250’. The productivity loss of industrially stems due to interference of this weed community was 17.5%, but there was no change of technological parameters of sugarcane.

References


